

## PATENT COOPERATION TREATY

## PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT  
(PCT Article 36 and Rule 70)

REC'D 31 JAN 2006

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Applicant's or agent's file reference GML2854	FOR FURTHER ACTION <span style="float: right;">See Notification of Transmittal of International Preliminary Examination Report (Form PCT/PEA/416)</span>	
International application No. PCT/GB2003/004526	International filing date (day/month/year) 21.10.2003	Priority date (day/month/year) 21.10.2003
International Patent Classification (IPC) or both national classification and IPC E02B3/06		
Applicant BUDD, Christopher Anthony		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 8 sheets, including this cover sheet.

This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of 8 sheets.

3. This report contains Indications relating to the following items:

- I  Basis of the opinion
- II  Priority
- III  Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV  Lack of unity of invention
- V  Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI  Certain documents cited
- VII  Certain defects in the international application
- VIII  Certain observations on the international application

Date of submission of the demand 11.05.2005	Date of completion of this report 30.01.2006
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EXAMINATION REPORT

International application No.

PCT/GB2003/004526

**I. Basis of the report**

1. With regard to the elements of the international application (Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17));

**Description, Pages**

1-30 as originally filed

**Claims, Numbers**

1-46 filed with telefax on 29.11.2005

**Drawings, Sheets**

1/13-13/13 as originally filed

2. With regard to the language, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- the language of publication of the international application (under Rule 48.3(b)).
- the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any nucleotide and/or amino acid sequence disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- contained in the international application in written form.
- filed together with the international application in computer readable form.
- furnished subsequently to this Authority in written form.
- furnished subsequently to this Authority in computer readable form.
- The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- the description, pages:
- the claims, Nos.:
- the drawings, sheets:

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5.  This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)).  
*(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)*

6. Additional observations, if necessary:

**IV. Lack of unity of invention**

1. In response to the invitation to restrict or pay additional fees, the applicant has:

- restricted the claims.
- paid additional fees.
- paid additional fees under protest.
- neither restricted nor paid additional fees.

2.  This Authority found that the requirement of unity of invention is not complied with and chose, according to Rule 68.1, not to invite the applicant to restrict or pay additional fees.

3. This Authority considers that the requirement of unity of invention in accordance with Rules 13.1, 13.2 and 13.3 is

- complied with.
- not complied with for the following reasons:

4. Consequently, the following parts of the international application were the subject of international preliminary examination in establishing this report:

- all parts.
- the parts relating to claims Nos. 1-23.

**V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

1. Statement

Novelty (N)	Yes: Claims	2-7,9-13,15-23
	No: Claims	1,8,14
Inventive step (IS)	Yes: Claims	17,18
	No: Claims	2-7,9-13,15,16,19-23
Industrial applicability (IA)	Yes: Claims	1-46
	No: Claims	

2. Citations and explanations

see separate sheet

Re Item I

**Basis of the report**

1. Reference is made to the following documents:

D1: US-A-3 846 990  
D2: US-A-3 848 419  
D3: US-B1-6 443 653  
D4: US-A-3 222 870

Re Item IV

**Lack of unity of invention**

2. This Authority considers that there are 5 inventions covered by the claims indicated as follows:

I: Claims 1-23 directed to a **breakwater device**.  
II: Claims 24-41 directed to a **propulsive device**.  
III: Claims 42-44 directed to a **multi-hulled vessel**.  
IV: Claim 45 directed to a **connecting means used to measure wave length**.  
V: Claim 46 directed to a **protection means for long vessels**.

2.1 The application lacks unity, a priori, within the meaning of Rule 13.1. Indeed, the 5 groups of inventions relate to different subject-matters, wherein no common inventive concept can be found linking together said groups of inventions.

This application is considered to be a "straightforward case", wherein, in order to adequately substantiate the lack of unity, it is sufficient to list the relevant subject-matter (see W7/92). Each group of claims clearly defines a completely different device.

Indeed, a breakwater device (claims 1-23) comprising one or more energy absorbers arranged between a plurality of structures having neutral buoyancy to remove energy from waves, is something different from a propulsive device (claims 24-41), which is intended to be a device to cause or move forwards.

(NOTE: a breakwater device is normally a massive wall built out into the sea to protect a shore or harbour from the force of water).

The difference between a multi-hulled vessel (claims 42-44) and a protection device for long vessel (claim 46) is obvious.

In claim 45, furthermore, the wording "A device as claimed in any preceding claim" is too vague and unclear (Art. 6 PCT), and does not contain, apart from the term "device", an indication of technical features for which the protection is requested and which can establish a clear common link with the other -non unitary- claimed devices. The subject matter of claim 45 was interpreted as meaning therefore a connecting means (to be used) between floating structures or hulls, for measuring wave length, height or period and/or providing a stabilised platform for equipment or personnel.

**Re Item V**

**Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

3. According to the requirements of the Rule 66.1(e) in the following it will be examined only the subject-matter of **claims 1-23**, corresponding to the first group of inventions;

**3.1 Independent claim 1.**

3.1.1 The present application does not meet the criteria of Article 33(1) PCT, because the subject-matter of claim 1 is not new in the sense of Article 33(2) PCT.

3.1.2 The document D3 discloses (the references in parentheses applying to this document):

**A breakwater device (title) in which one or more energy absorbers (column 1, lines 37-41; figures 1 and 2) arranged between a plurality of structures having neutral buoyancy (fig.1, reference sign 8="floats"; reference sign 1="modules") are adapted to permanently remove energy from waves (column 2, lines 29-32; claims 1 and 2) by resisting the relative motion of the structures caused by opposing forces which are created between those**

structures by virtue of the fact that the structures are located in different parts of the irrotational oscillating cycle of the water mass which occurs naturally during the passage of waves (figures 1 and 2; column 2, lines 15-49).

The subject-matter of claim 1 is consequently not novel.

### 3.2 Claims 2-22

3.2.1 The present application does not meet the criteria of Article 33(1) PCT, because the subject-matter of claims 8 and 14, is not new in the sense of Article 33(2) PCT: see D3, fig.1, reference sign 1="modules".

3.2.2 Inasmuch as the features of the remaining claims 2-7, 9-13, 15, 16, 19-23 are not directly known from the combination of documents D3 and D1, or from the other documents cited in the search report (see D2, D4), they obviously concern only minor modifications thereto which come within the customary practice followed by a person skilled in the art of constructing and installing wave energy dissipating or absorbing devices, or floating barriers in general, and which therefore cannot be regarded as inventive (Article 33(3) PCT).

In particular:

As for claims 10 and 11: the claimed "ratio(s)" represent an obvious selection of values commonly used in defining plate structures.

As for claims 19 and 20: a device comprising a piston and a cylinder, with a fluid arranged in-between, is known to the person skilled in the art of designing energy absorbers (see also D3, Fig.2).

As for claim 21: see D1, figures;

As for independent claim 22: A system comprising a plurality of breakwater devices according to claims 1 is already described in D1 (see D1, figures 2A-

2C), and it would be capable, in combination with document D3, of (suitable for) maintaining or modifying coastal deposition and/or erosion patterns (Art.33(3) PCT); see also D2, figures 2A-2C.

**As for independent claim 23:**

It would be obvious for a person skilled in the art of installing wave energy dissipating devices to use the device as disclosed in D1, in combination with document D3, for controlling the costal erosion (Art.33(3) PCT).

3.2.3 The subject-matter of claims 17, 18 is neither anticipated nor rendered obvious by the available prior art (Art.33(1)-(3)).  
The devices described in these claims solve the problem of converting the energy absorbed by the waves in a more efficient and flexible way.

4. The subject-matter according to any of claims 1-46 is industrially applicable (Art. 33(4) PCT).

**5. REMARKS**

5.1 To meet the requirements of Rule 6.3(b) PCT, the independent claims should have been properly cast in the two part form, with those features which in combination are part of the prior art being placed in the preamble.

5.2 Reference signs in parentheses should have been inserted in the claims to increase their intelligibility; this applies to both the preamble and characterising portion (Rule 6.2(b) PCT).

5.3 To meet the requirements of Rule 5.1(a)(ii) PCT, documents D1-D3 should have been identified in the description and the relevant background art disclosed therein should have been briefly discussed.

5.4 The definition of the problem underlying the invention should be presented in

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the description in such terms that its solution can be better understood in view of the disclosure of documents D1-D3 (Rule 5.1(a)(iii) PCT).

5.5 The expression "as described by the appended claims" should have been added at the end of the description, page 30, to avoid an expansion of the extent of protection in some vague and not precisely defined way (PCT-Guidelines C-III, 4.3a and 6.5).

## CLAIMS

1. A breakwater device in which one or more energy absorbers arranged between a plurality of structures having neutral buoyancy are adapted to permanently remove energy from waves by resisting the 5 relative motion of the structures caused by opposing forces which are created between those structures by virtue of the fact that the structures are located in different parts of the irrotational oscillating cycle of the water mass which occurs naturally during the passage of waves.
2. A breakwater device as claimed in claim 1 in which the structures 10 comprise first and second structures, which in use are arranged substantially parallel one to another.
3. A breakwater device according to claim 2 wherein the breakwater device includes a third structure, which in use is arranged substantially parallel to the other two structures.
- 15 4. A breakwater device according to claim 3 wherein the distance between the first and second structures is substantially twice the distance between the second and third structures.
5. A breakwater device according to claim 3 or claim 4 wherein the 20 distance between any two of the structures is  $(n + \frac{1}{2})\lambda$  where  $\lambda$  is a wavelength of the waves in the particular location where the breakwater is to be deployed and  $n$  is zero or a positive integer.
6. A breakwater device according to claim 5 wherein the distance 25 between first and second structures is  $\lambda/2$  and  $\lambda$  is the maximum wavelength of waves in that particular location where the breakwater is to be deployed.

7. A breakwater device according to any preceding claim comprising a mechanical interconnection from the first to the second structure, and from the second to the third structure, the interconnections supporting the energy absorbers.
- 5 8. A breakwater device according to any of claims 1 to 7 wherein the structures are substantially parallelepiped structures.
9. A breakwater device according to claim 8 wherein the structures are plate-like and plate-like is defined as the ratio between the area of the structure, which is presented to the direction of a wave, and the square of 10 the thickness of the structure, said ratio being greater than 10.
10. A breakwater device as claimed in claim 9 in which said ratio is greater than 20.
11. A breakwater device as claimed in claim 10 in which said ratio is greater than 30.
12. A breakwater device according to claim 9 wherein the height of the plate like structures is less than a half the wavelength ( $\lambda/2$ ) of waves in 15 that particular location where the breakwater is to be deployed.
13. A breakwater device as claimed in claim 12 in which said height is less than ( $\lambda/5$ ) of the waves in that particular location.
- 20 14. A breakwater device according to any preceding claim wherein the structures are orientated substantially vertically.
15. An energy absorbing breakwater device according to any one of claims 1 to 13 wherein the plate like structures are orientated horizontally from the surface downwards.

16. A breakwater device according to any preceding claim in which the or each energy absorber comprises water chokes arranged to squeeze water through a throttle so as to dissipate energy upon relative displacement of the structures.

5 17. A breakwater device according to any of claims 1 to 15 in which the or each energy absorber comprises an electromagnetic arrangement, sealed inside a suitable waterproof container, configured to generate an electromotive force upon relative displacement of the structures.

10 18. A breakwater device according to any one of claims 1 to 15 in which the or each energy absorber includes rack and pinion arrangements fitted with suitable gears to convert linear to rotating motion.

15 19. A breakwater device according to any of claims 1 to 15 in which the or each energy absorber comprises a piston and cylinder arrangement so arranged as to act as a dashpot.

20. A breakwater device according to any of claims 1 to 15 in which the or each energy absorber includes a bi-directional piston and cylinder, with a fluid arranged to pass through energy absorbers so as to absorb wave energy when the structures move towards one another as well as away from one another.

20 21. A breakwater device according to any preceding claim wherein the breakwater device, in use, is positioned in a body of water, such as an area of open sea, so that the lengthwise axes of the structures extend substantially parallel to an incident wave front.

22. A breakwater system comprising a plurality of breakwater devices according to any of claims 1 to 21, said system being capable of maintaining or modifying coastal deposition and/or erosion patterns

23. A method of controlling coastal erosion using the breakwater devices of any of claims 1 to 21 or the system of claim 22.

24. A propulsive device for use in a body of water comprising first and second submerged structures arranged substantially parallel to one another and connected by a strut, the first and second structures both comprising non-return valve arrays, which arrays permit water to flow through the respective array in one direction, both arrays being arranged to be operable in the same direction whereby when the device is orientated generally orthogonal to the incident wavefront with the structures spaced apart by approximately half a wave length of waves in the body of water, the natural irrotational oscillation of the water mass acts in the reverse direction onto the one valve array compared with the other.

25. A propulsive device according to claim 24 wherein the submerged structures are of parallelepiped plate like form.

26. A propulsive device as claimed in claim 24 or claim 25 wherein the structures are orientated substantially vertically.

27. A propulsive device as claimed in any one of claims 24 to 26 wherein the valve arrays are arranged such that the direction of irrotational oscillating motion of the water mass closes one array and moves it in that direction carrying the whole assembly with it whilst the reverse irrotation of the water mass acting on the other array opens it and allows the water mass to pass through, with the reverse happening as the

wave system passes wherein the first array is opened and the second closed but with the direction of motion of the overall device remaining the same as before.

28. A propulsive device as claimed in any one of claims 24 to 27  
5 wherein both sets of non-return valve arrays are capable of being set to  
open with the direction of the oncoming wave crests whereby propulsion  
is achieved in the reverse direction through the closing of the non-return  
valve array in the trough by the reverse irrotational oscillating motion  
occurring in that part of the water mass moving the whole assembly  
10 against the direction of the waves.

29. A propulsive device as claimed in any one of claims 24 to 27 in  
which both sets of non-return valves are arranged to be set to close with  
the direction of the oncoming wave crests wherein propulsion is achieved  
in the same direction as the wave crests and the non-return valves open in  
15 the wave troughs to allow the reverse oscillating mass to pass through.

30. A propulsive device as claimed in any one of claims 24 to 27  
comprising control means adapted to change the direction of operation of  
the non-return valves so as to change the direction of propulsion of the  
assembly whilst in operation.

20 31. A propulsive device as claimed in any one of claims 24 to 30 which  
is fitted with rudders to enable the device to "tack" at an angle into or  
with the direction of the waves.

32. A propulsive device as claimed in claim 30 in which the strut is of  
adjustable length, and wherein said control means is arranged to be  
25 operable independently on one structure with respect to the other so as to  
enable opposing motion of the structures to be achieved by wave force to

adjust the strut for matching the nominal spacing of the structures to changing wave lengths whilst in operation.

33. A propulsive device as claimed in any one of claims 24 to 32 comprising an energy absorbing device associated with the strut and 5 operable to extract energy.

34. A propulsion device as claimed in claim 33 in which the energy absorbing device is arranged to power an additional propeller type propulsion means.

35. A propulsive device according to claims 24 and 25 wherein the plate 10 like structures are both horizontally orientated from the surface downwards.

36. A propulsive device according to any one of claims 24 to 35 wherein the device comprises a third structure parallel with but spaced from the first and second structures.

15 37. A propulsive device according to claim 36 wherein the third structure is adjustable relative to the other two.

38. A propulsion device according to any one of claims 24 to 37 wherein the non-return valves are louver type valves.

20 39. A method of using a propulsive device as claimed in any one of claims 24 to 38 wherein the propulsive forces produced are used to provide a static or moving force with, against or at an angle to the prevailing waves.

40. A method of using a propulsive device as claimed in any one of claims 24 to 38 wherein the forces are used for towing.

41. A method of using a propulsive device as claimed in claim 40 wherein the energy absorbed in creating the forces and motions is used to form a calm area of sea behind the device.

42. A multi-hulled vessel comprising at least two hulls which are 5 connected by a sliding or calliper type link wherein the hulls can move away and towards each other whilst remaining connected and mainly parallel to each other.

43. A vessel as claimed in claim 42 wherein the available relative motion between the hulls is large enough to accommodate the differential 10 motion created by different parts of the irrotational oscillating mass of water that one hull is located in, in relation to the other, during the passage of the craft through the waves thereby preventing large sideways forces being applied to the hulls by the irrotating water masses.

44. A vessel as claimed in claim 42 or 43 wherein an energy absorbing 15 device operable by virtue of the differential forces and motions which can occur between the hulls, is arranged to extract energy which can be used to propel the craft generally in the fore and aft directions of the hulls using propellers or other mechanical means.

45. A device as claimed in any preceding claim in which the connecting 20 means between the floating structures or hulls is used to measure wave length, height or period and/or provide a stabilised platform for equipment or personnel.

46. A protection means for long vessels, which straddle in a diagonal 25 way more than one wave, comprising horizontal differential articulation or double articulation of the structure along its length to accommodate the

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different irrotational patterns occurring in the water mass in different parts of the wave system.

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AMENDED SHEET

30-11-2005